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Date: October 11, 2006

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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re patent application of:

Appellants: Angela T. Hui

Examiner: Jeffrie R. Lund

Serial No: 10/817,131

Art Unit: 1763

Filing Date: April 2, 2004

Title: IN-SITU SURFACE TREATMENT FOR MEMORY CELL FORMATION

**Mail Stop Appeal Brief-Patents  
Commissioner for Patents  
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**APPEAL BRIEF**

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Dear Sir:

Appellant's submit this brief in connection with an appeal of the above-identified patent application. Payment is being submitted via credit card in connection with all fees due regarding this appeal brief. In the event any additional fees may be due and/or are not covered by the credit card, the Commissioner is authorized to charge such fees to Deposit Account No. 50-1063 [AMDP879US].

**I. Real Party in Interest (37 C.F.R. §41.37(c)(1)(i))**

The real party in interest in the present appeal is Advanced Micro Devices, Inc., the assignee of the present application.

**II. Related Appeals and Interferences (37 C.F.R. §41.37(c)(1)(ii))**

Appellant, appellant's legal representative, and/or the assignee of the present application are not aware of any appeals or interferences which may be related to, will directly affect, or be directly affected by or have a bearing on the Board's decision in the pending appeal.

**III. Status of Claims (37 C.F.R. §41.37(c)(1)(iii))**

Claims 1-20 stand rejected by the Examiner. The rejection of claims 1-20 is being appealed. Claims 21-37 stand withdrawn.

**IV. Status of Amendments (37 C.F.R. §41.37(c)(1)(iv))**

The Examiner has not entered the amendments submitted after the Final Office Action. (See Advisory Action from Examiner dated July 17, 2006).

**V. Summary of Claimed Subject Matter (37 C.F.R. §41.37(c)(1)(v))****A. Independent claim 1**

Independent claim 1 recites a system for in-situ surface treatment in fashioning a memory cell. The system comprises a gas distribution system 1012 that selectively provides a fluorine (F) based gas into a processing chamber. Moreover, the system comprises an excitation system 1036 that facilitates transforming a conductive surface of a substrate into a passive layer. More particularly, the excitation system 1036 electrically excites the fluorine based gas to establish a plasma in the chamber which interacts with a conductive surface to transform the surface from a conductive material into a passive layer that includes a conductivity facilitating compound having conductivity facilitating properties (See, e.g. Figure 10, and corresponding text, page 19, line 16 – page 26, line 13).

**B. Dependent claim 4**

Dependent claim 4 recites the system of claim 1 wherein the conductive surface that is transformed into a passive layer is part of an upper portion of a deposition of conductive material placed within and exposed to the plasma by a trench formed within one or more layers of dielectric material spread across a wafer whereon the memory cell fashioning occurs. (*See, e.g.* Figure 14, and corresponding text, page 28, lines 17 – 21).

**C. Dependent claim 17**

Dependent claim 17 recites the system of claim 1 further comprising a measurement system 1044 that monitors the passive layer being formed and a control system 1032 operatively coupled to the measurement system 1044, gas distribution system 1012 and excitation system 1036, the control system obtaining readings taken by the measurement and selectively adjusting at least one of the gas distribution system 1012 and excitation system 1036 in response thereto to facilitate at least one of forming the passive layer to a desired thickness, forming the passive layer at a desired rate, forming the passive layer to a desired composition and forming the passive layer at a desired location. (*See, e.g.* Figure 10, and corresponding text, page 19, line 16 – page 26, line 13).

**VI. Grounds of Rejection to be Reviewed on Appeal (37 C.F.R. §41.37(c)(1)(vi))**

**A.** Whether claims 1-16 and 20 are anticipated under 35 U.S.C. §102(e) by Carducci *et al.* (US 2003/0037880).

**B.** Whether claims 1- 20 are anticipated under 35 U.S.C. §102(b) by Grimbergen *et al.* (US 6,835,275).

**C.** Whether claims 17-19 are unpatentable under 35 U.S.C. §103(a) over Carducci *et al.* in view of Grimbergen *et al.*

## VII. Argument (37 C.F.R. §41.37(c)(1)(vii))

### A. Rejection of Claims 1-16 and 20 Under 35 U.S.C. §102(b)

Claims 1-16 and 20 stand rejected under 35 U.S.C. §102(b) as being anticipated by Carducci *et al.* (US 2003/0037880). Appellant's representative respectfully requests that this rejection be reversed for at least the following reasons. Carducci *et al.* fails to disclose all features of the subject claims.

A single prior art reference anticipates a patent claim only if it *expressly or inherently describes each and every limitation set forth in the patent claim*. *Trintec Industries, Inc. v. Top-U.S.A. Corp.*, 295 F.3d 1292, 63 USPQ2d 1597 (Fed. Cir. 2002); *See Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). The *identical invention must be shown in as complete detail as is contained in the ... claim*. *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989) (emphasis added).

The claimed invention relates to *in-situ* surface treatment for memory cell formation. In particular, independent claim 1 recites a system for *in-situ* surface treatment in fashioning a memory cell comprising a gas distribution system that selectively provides a fluorine (F) based gas into a processing chamber; and *an excitation system that electrically excites the fluorine based gas to establish a plasma in the chamber which interacts with a conductive surface to transform the surface from a conductive material into a passive layer*. More particularly, the invention as claimed provides a novel system that creates an underlying conductivity-facilitating (*e.g.* passive) layer adjacent to an organic layer *via* plasma treatment. The physical properties of the passive layer can be adjusted according to the type of organic memory cell being formed. Carducci *et al.* is silent regarding such features of the claimed invention.

Carducci *et al.* provides a thermally controlled plasma etch chamber for etch processing of substrates at sub-atmospheric pressure. Carducci *et al.* is merely concerned with preparing a substrate for etching. The cited reference does not teach, suggest, or even contemplate memory cell formation let alone an excitation system that exposes a conductive layer to be transformed into a passive layer as in the claimed invention. Instead, Carducci *et al.* heats a resistive top dielectric layer of a substrate prior to etch processing *via* a plasma without disclosing an

excitation system that is capable of acting upon a conductive layer, as afforded by the memory cell formation system of claim 1. Consequently, the cited reference does not disclose *an excitation system that electrically excites the fluorine based gas to establish a plasma in the chamber which interacts with a conductive surface to transform the surface from a conductive material into a passive layer*, as recited in independent claim 1.

Moreover, for example, the conductive material in claim 1 is an underlying layer exposed to the plasma *by a trench formed within one or more layers of dielectric material* spread across a wafer whereon the memory cell fashioning occurs, as recited in claim 4. The Examiner incorrectly contends that the apparatus of Carducci *et al.* is capable of processing substrates having the claimed layers and features. Carducci *et al.* processes a resistive dielectric layer of a substrate surface, but does not contemplate an upper portion of a deposition of conductive material being exposed to the plasma *by a trench formed within one or more layers of dielectric material* spread across a wafer whereon the memory cell fashioning occurs. The claimed invention, for example, employs a trench in the dielectric material of the wafer to allow the upper surface of an underlying conductive material to be exposed to a plasma in order to transform the upper portion into a passive layer to allow a selectively conductive layer to be grown out of the conductive material. To the contrary, the reference is directed towards generally exposing the resistive top dielectric layer of the substrate to the plasma for etch preparation without providing a system that limits exposing the plasma to conductive material that is exposed by a trench within one or more layers of dielectric material, as in the claimed invention.

In view of at least the foregoing, it is readily apparent that Carducci *et al.* fails to teach the identical invention in as much detail as is contained in the subject claims. Accordingly, this rejection should be reversed.

#### **B. Rejection of Claims 1-20 Under 35 U.S.C. §102(e)**

Claims 1-20 stand rejected under 35 U.S.C. §102(e) as being anticipated by Grimbergen *et al.* (US 6,835,275). Appellant's representative respectfully requests that this rejection be reversed for at least the following reasons. Grimbergen *et al.* fails to disclose all aspects recited in the subject claims.

Independent claim 1 recites *an excitation system that electrically excites the fluorine-based gas to establish a plasma in the chamber which interacts with a conductive surface to*

*transform the surface from a conductive material into a passive layer.* Grimbergen *et al.* relates to reducing deposition of process residues on chamber surfaces by employing various chamber recess implementations. Grimbergen *et al.* establishes a plasma in the chamber to facilitate etching of gates, contact holes and interconnect lines atop the resistive dielectric layer of the substrate, but the excitation system taught by the cited reference is incapable of producing a plasma that acts upon a conductive surface as in the claimed invention. Rather, the cited reference provides a system that acts upon the top dielectric layer of a substrate in order to prepare the substrate for etching, but does not disclose a system that is able to facilitate memory cell formation. Consequently, Grimbergen *et al.* fails to disclose the system of independent claim 1.

Moreover, as discussed *supra*, the conductive material in claim 1 is an underlying layer exposed to the plasma *by a trench formed within one or more layers of dielectric material* spread across a wafer whereon the memory cell fashioning occurs, as recited in claim 4. Since Grimbergen *et al.* discloses a rudimentary system that exposes a resistive dielectric layer to a plasma to facilitate etching, the reference inherently does not disclose the excitation system of claim 1 which transforms a conductive layer into a passive layer, wherein the portion of the conductive layer that undergoes the transformation process is exposed to the plasma *by a trench formed within one or more layers of dielectric material*, as afforded by claim 4.

Furthermore, claim 17 recites the system of claim 1, further comprising...a control system operatively coupled to the measurement system, gas distribution system and excitation system, *the control system obtaining readings taken by the measurement and selectively adjusting at least one of the gas distribution system and excitation system in response thereto to facilitate at least one of forming the passive layer to a desired thickness, forming the passive layer at a desired rate, forming the passive layer to a desired composition and forming the passive layer at a desired location.* Since Grimbergen *et al.* does not contemplate a system for formation of memory cells or an associated excitation system that can act upon a conductive surface to produce the required passive layer for such memory cell formation, Grimbergen *et al.* is further incapable of providing a control system that optimizes such passive layer formation. Consequently, Grimbergen *et al.* is silent regarding the features recited in claim 17.

In view of at least the foregoing, it is readily apparent that Grimbergen *et al.* fails to teach all limitations of the subject claims. Accordingly, this rejection should be reversed.

**C. Rejection of Claims 17-19 Under 35 U.S.C. §103(a)**

Claims 17-19 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Carducci *et al.* in view of Grimbergen *et al.* Withdrawal of this rejection is respectfully requested for at least the following reasons. The subject claims depend from independent claim 1. As discussed *supra*, Carducci *et al.* and Grimbergen *et al.* fail to disclose or suggest all aspects of independent claim 1. Moreover, as noted above, Grimbergen *et al.* does not disclose all aspects of claim 17. Carducci *et al.* does not compensate for the aforementioned deficiencies of Grimbergen *et al.* As conceded by the Examiner, Carducci *et al.* does not teach or suggest a measurement system or a way to control the apparatus in real-time. Consequently, Carducci *et al.* is further silent regarding *a measurement system that monitors the passive layer being formed and a control system obtaining readings taken by the measurement and selectively adjusting at least one of the gas distribution system and excitation system in response thereto to facilitate at least one of forming the passive layer to a desired thickness, forming the passive layer at a desired rate, forming the passive layer to a desired composition and forming the passive layer at a desired location*, as recited in claim 17. Accordingly, this rejection should be withdrawn.

**D. Conclusion**

For at least the above reasons, the claims currently under consideration are believed to be patentable over the cited references. Accordingly, it is respectfully requested that the rejections of claims 1-20 be reversed.

If any additional fees are due in connection with this document, the Commissioner is authorized to charge those fees to Deposit Account No. 50-1063 [AMDP879US].

Respectfully submitted,  
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**VIII. Claims Appendix (37 C.F.R. §41.37(c)(1)(viii))**

1. A system for in-situ surface treatment in fashioning a memory cell comprising:
  - a gas distribution system that selectively provides a fluorine (F) based gas into a processing chamber; and
    - an excitation system that electrically excites the fluorine based gas to establish a plasma in the chamber which interacts with a conductive surface to transform the surface from a conductive material into a passive layer that includes a conductivity facilitating compound having conductivity facilitating properties.
2. The system of claim 1 wherein the fluorine based gas includes at least one of CF<sub>4</sub> and SF<sub>6</sub>.
3. The system of claim 1 wherein the passive layer includes at least one of copper sulfide (Cu<sub>2</sub>S, CuS), copper oxide (CuO, Cu<sub>2</sub>O), manganese oxide (MnO<sub>2</sub>), titanium dioxide (TiO<sub>2</sub>), indium oxide (I<sub>2</sub>O<sub>4</sub>), silver sulfide (Ag<sub>2</sub>S, AgS) and iron oxide (Fe<sub>3</sub>O<sub>4</sub>).
4. The system of claim 1 wherein the surface is part of an upper portion of a deposition of conductive material placed within and exposed to the plasma by a trench formed within one or more layers of dielectric material spread across a wafer whereon the memory cell fashioning occurs.
5. The system of claim 1 wherein the passive layer has at least one of a thickness range of about 2 Å to about 0.1 μm, about 10 Å to about 0.01 μm and about 50 Å to about 0.005 μm.
6. The system of claim 1 wherein the passive layer has a refractive index from about 2.0 to 2.21.
7. The system of claim 1 wherein the passive layer has a resistivity of about 5.7 x 10<sup>-2</sup> Ohm/cm.

8. The system of claim 1 wherein the passive layer is transparent with a transmittance of about 60% between 600 and 700 nm.

9. The system of claim 4 wherein a stack formed on a substrate of the wafer comprises the memory cell and includes an organic layer formed over the passive layer and a conductive layer formed over the organic layer, the organic and conductive layers formed within the trench.

10. The system of claim 9 wherein the conductive material under the passive layer serves as a bottom electrode and the conductive layer overlying the organic layer serves as a top electrode.

11. The system of claim 9, the conductive material and the conductive layer including at least one of copper, aluminum, chromium, germanium, gold, magnesium, manganese, indium, iron, nickel, palladium, platinum, silver, titanium, zinc, alloys thereof, indium-tin oxide, polysilicon, doped amorphous silicon, metal silicides, Hastelloy®, Kovar®, Invar, Monel®, Inconel®, brass, stainless steel and magnesium-silver alloy.

12. The system of claim 9, the conductive material and the conductive layer having at least one of thickness ranges of about  $0.01 \mu\text{m}$  to about  $10 \mu\text{m}$ , about  $0.05 \mu\text{m}$  to about  $5 \mu\text{m}$ , and about  $0.1 \mu\text{m}$  to about  $1 \mu\text{m}$ .

13. The system of claim 9, the organic layer including at least one of polyacetylene (cis or trans), polyphenylacetylene (cis or trans), polydiphenylacetylene, polyaniline, poly(p-phenylene vinylene), polythiophene, polyporphyrins, porphyrinic macrocycles, thiol derivatized polyporphyrins, polymetallocenes, polyferrocenes, polyphthalocyanines, polyvinylenes and polystyroles.

14. The system of claim 9, the organic layer having at least one of thickness ranges of about  $0.001 \mu\text{m}$  to about  $5 \mu\text{m}$ , about  $0.01 \mu\text{m}$  to about  $2.5 \mu\text{m}$  and about  $0.05 \mu\text{m}$  to about  $1 \mu\text{m}$ .

15. The system of claim 9, the dielectric material including at least one of silicon oxide ( $\text{SiO}$ ), silicon dioxide ( $\text{SiO}_2$ ), silicon nitride ( $\text{Si}_3\text{N}_4$ ), ( $\text{SiN}$ ), silicon oxynitride ( $\text{SiO}_x\text{N}_y$ ), fluorinated silicon oxide ( $\text{SiO}_x\text{F}_y$ ), polysilicon, amorphous silicon, tetraethylorthosilicate (TEOS), phosphosilicate glass (PSG) and borophosphosilicate glass (BPSG).

16. The system of claim 9 wherein a barrier layer at least partially surrounds the conductive material so as to mitigate diffusion of the conductive material into the dielectric material and/or substrate.

17. The system of claim 1 further comprising:

a measurement system that monitors the passive layer being formed;

a control system operatively coupled to the measurement system, gas distribution system and excitation system, the control system obtaining readings taken by the measurement and selectively adjusting at least one of the gas distribution system and excitation system in response thereto to facilitate at least one of forming the passive layer to a desired thickness, forming the passive layer at a desired rate, forming the passive layer to a desired composition and forming the passive layer at a desired location.

18. The system of claim 17 further comprising:

a temperature system that regulates the temperature within the chamber; and

a pressure system that regulates the pressure within the chamber, the control system operatively coupled to the temperature and pressure systems and selectively adjusting at least one thereof in response to readings taken by the measurement system.

19. The system of claim 18 wherein the measurement system is implemented utilizing at least one of optical interference, scatterometry, IR spectroscopy, ellipsometry, scanning electron microscopy, synchrotron and x-ray diffraction based techniques.

20. The system of claim 1 wherein the excitation system includes a voltage source.

21. (Withdrawn) A method of treating a surface *in situ* in fashioning a memory cell on a wafer comprising:

selectively providing a fluorine (F) based gas into a processing chamber;

exciting the fluorine based gas to generate a plasma; and

converting, *via* interaction with the plasma, the surface from a conductive material into a passive layer that includes a conductivity facilitating compound having conductivity facilitating properties.

22. (Withdrawn) The method of claim 21 further comprising:

measuring at least one of the thickness, rate of formation, composition and location of the passive layer being developed; and

selectively controlling in response to the measurements at least one of pressure within the chamber, temperature within the chamber, concentration of gases within the chamber, rate of flow of gases into the chamber, volume of gases distributed into the chamber and excitation provided within the chamber.

23. (Withdrawn) The method of claim 22 wherein the measurements are taken *via* at least one of optical interference, scatterometry, IR spectroscopy, ellipsometry, scanning electron microscopy, synchrotron and x-ray diffraction based techniques.

24. (Withdrawn) The method of claim 22 further comprising:

mapping the wafer into one or more grids; and

obtaining measurements at the grid mapped locations.

25. (Withdrawn) The method of claim 21 wherein the fluorine based gas includes at least one of CF<sub>4</sub> and SF<sub>6</sub>.

26. (Withdrawn) The method of claim 21 wherein the passive layer includes at least one of copper sulfide ( $\text{Cu}_2\text{S}$ ,  $\text{CuS}$ ), copper oxide ( $\text{CuO}$ ,  $\text{Cu}_2\text{O}$ ), manganese oxide ( $\text{MnO}_2$ ), titanium dioxide ( $\text{TiO}_2$ ), indium oxide ( $\text{I}_3\text{O}_4$ ), silver sulfide ( $\text{Ag}_2\text{S}$ ,  $\text{AgS}$ ) and iron oxide ( $\text{Fe}_3\text{O}_4$ ), the method further comprising:

forming the passive layer to have at least one of a refractive index from about 2.0 to 2.21, a resistivity of about  $5.7 \times 10^{-2}$  Ohm/cm, a transparency with a transmittance of about 60% between 600 and 700 nm and a thickness between about 200 to 600 nm.

27. (Withdrawn) The method of claim 21 wherein the surface is part of an upper portion of a deposition of conductive material placed within and exposed to the plasma by a trench formed within one or more layers of dielectric material spread across the wafer.

28. (Withdrawn) The method of claim 27 wherein a stack formed on a substrate of the wafer comprises the memory cell and includes an organic layer formed over the passive layer and a conductive layer formed over the organic layer, the organic and conductive layers formed within the trench.

29. (Withdrawn) The method of claim 28 wherein the conductive material under the passive layer serves as a bottom electrode and the conductive layer overlying the organic layer serves as a top electrode.

30. (Withdrawn) The method of claim 28, the conductive material and the conductive layer including at least one of copper, aluminum, chromium, germanium, gold, magnesium, manganese, indium, iron, nickel, palladium, platinum, silver, titanium, zinc, alloys thereof, indium-tin oxide, polysilicon, doped amorphous silicon, metal silicides, Hastelloy®, Kovar®, Invar, Monel®, Inconel®, brass, stainless steel and magnesium-silver alloy.

31. (Withdrawn) The method of claim 28, the organic layer including at least one of polyacetylene (cis or trans), polyphenylacetylene (cis or trans), polydiphenylacetylene, polyaniline, poly(p-phenylene vinylene), polythiophene, polyporphyrins, porphyrinic macrocycles, thiol derivatized polyporphyrins, polymetallocenes, polyferrocenes, polyphthalocyanines, polyvinylenes and polystyroles.

32. (Withdrawn) The method of claim 28, the dielectric material including at least one of silicon oxide (SiO), silicon dioxide (SiO<sub>2</sub>), silicon nitride (Si<sub>3</sub>N<sub>4</sub>), (SiN), silicon oxynitride (SiO<sub>x</sub>N<sub>y</sub>), fluorinated silicon oxide (SiO<sub>x</sub>F<sub>y</sub>), polysilicon, amorphous silicon, tetraethylorthosilicate (TEOS), phosphosilicate glass (PSG) and borophosphosilicate glass (BPSG).

33. (Withdrawn) The method of claim 28 further comprising:

forming a barrier layer that at least partially surrounds the conductive material so as to mitigate diffusion of the conductive material into the dielectric material and/or substrate.

34. (Withdrawn) A memory cell comprising:

a deposit of conductive material that serves as a bottom electrode, the bottom electrode formed on a substrate on a wafer and in a trench formed within a dielectric material spread across the wafer;

a passive layer having conductivity facilitating properties, the passive layer formed out of an upper portion of the bottom electrode *via* a plasma which interacts with the conductive material to convert the upper portion of the bottom electrode so as to include, at least, a conductivity facilitating compound, the plasma being generated from a fluorine (F) based gas and having access to the upper portion of the bottom electrode by way of the trench;

an organic layer formed over the passive layer; and

a layer of conductive material formed over the organic layer to serve as a top electrode.

35. (Withdrawn) The memory cell of claim 34 further comprising:  
a barrier layer that at least partially surrounds the bottom electrode so as to mitigate diffusion of the conductive material into the dielectric material and/or substrate.
36. (Withdrawn) The memory cell of claim 34 wherein the bottom and top electrodes include at least one of copper, aluminum, chromium, germanium, gold, magnesium, manganese, indium, iron, nickel, palladium, platinum, silver, titanium, zinc, alloys thereof, indium-tin oxide, polysilicon, doped amorphous silicon, metal silicides, Hastelloy®, Kovar®, Invar, Monel®, Inconel®, brass, stainless steel and magnesium-silver alloy.
37. (Withdrawn) The memory cell of claim 34 wherein the organic layer includes at least one of polyacetylene (cis or trans), polyphenylacetylene (cis or trans), polydiphenylacetylene, polyaniline, poly(p-phenylene vinylene), polythiophene, polyporphyrins, porphyrinic macrocycles, thiol derivatized polyporphyrins, polymetallocenes, polyferrocenes, polyphthalocyanines, polyvinylenes and polystyroles.

**IX. Evidence Appendix (37 C.F.R. §41.37(c)(1)(ix))**

None.

**X. Related Proceedings Appendix (37 C.F.R. §41.37(c)(1)(x))**

None.